IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:	)	Docket No.: 23742-011
Rodney Stuart HOWARD	)	Confirmation No.: *Unknown*
Serial No.: *Unknown*	)	Examiner: *Unknown*
Filed: *Herewith*	)	Group Art Unit: *Unknown*

For: DRIVE DISCONNECT DEVICE

SUBMISSION OF PRIORITY DOCUMENT

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant claims foreign priority benefits under 35 U.S.C. §119, for the above-identified patent application, based on the following foreign application:

GB 0217309.4 filed 25 July, 2002.

In support of this claim, a certified copy of said original foreign application is filed herewith.

Respectfully submitted,

MINTZ, LEVIN, COHN, FERRIS, GLOVSKY
and POPEO, P.C.

By _____
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Dated: July 11, 2003

The Patent Office
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NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

I also certify that by virtue of an assignment registered under the Patents Act 1977, the application is now proceeding in the name as substituted.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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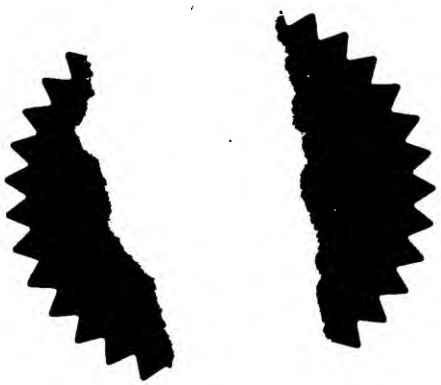

Signed K Behen

Dated 16 June 2003

GB 0217309.4

By virtue of a direction given under Section 30 of the Patents Act 1977, the application is proceeding in the name of

GOODRICH CONTROL SYSTEMS LIMITED,
c/o Ernst & Young,
400 Capability Green,
Luton,
Bedfordshire,
LU1 3LU,
United Kingdom

Incorporated in the United Kingdom,

[ADP No. 08603839001]

Patents Form 1/77

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26JUL02 E736219-1 D01038
P01/7700 0.00-0217309.4

1/77

Request for grant of a patent

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25 JUL 2002

The Patent Office
Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference P104294GB/SAB 48165

2. Patent application number *(The Patent Office will fill in this part)* 0217309.4

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Lucas Industries Limited
Stratford Road
Solihull
B90 4LA
United Kingdom

SECTION 30 (1977 ACT) APPLICATION FILED 31/1/03

Patents ADP number *(if you know it)* 5766946002

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention Drive Disconnect Device

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

WITHERS & ROGERS
Goldings House
2 Hays Lane
London
SE1 2HW

Patents ADP number *(if you know it)* 1776001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
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YES

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	7
Claim(s)	
Abstract	
Drawing (s)	1 +1

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Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature C Withers & Rogers Date 24th July 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

Simon A Beck 0117 925 3030

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After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least six weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

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P104294GB

DRIVE DISCONNECT DEVICE

The present invention relates to a drive disconnect device. Such a device is suitable for controllably disconnecting the drive between a drive shaft and a driven shaft. The drive disconnect device is especially suited for controlled disconnection of a generator from a prime mover.

US 4,997,072 discloses a disconnect device in which a solenoid holds a spring operated annular cam assembly in a retained position. The retraction of the solenoid allows the cam to slide into a position where it engages with a rotating pin on the shaft of the drive assembly and moves the pin against a compression spring to a position where it allows a driving element to move to a position where it drivingly disconnects input and output shafts. Such an arrangement is difficult to test as the annular cam relies on the shafts to be rotating in order to give rise to the disconnect operation.

US 4,685,550 discloses an arrangement in which coaxial input and output shafts are coupled together by an axially slidable drive connection element which is normally held in position by a detent mechanism. A magnetic coil encircles the output shaft and can be energised to attract an end plate which in turn is coupled to a cylindrical element disposed within one of the shafts to displace it axially such that a detent ball can fall into a pocket, thereby allowing the drive to become disconnected. The magnetic coil must provide the entirety of the force required to overcome any friction and the spring biasing of the detent mechanism, and the disengagement of the driving and driven elements depends upon there being sufficient torque transmitted therebetween to generate displacement forces acting between inclined jaws within a clutch mechanism. Such a mechanism may not always operate to disconnect a load. For example, in the context of an avionics generator, suspected failure of the generator may result in an immediate electrical disconnection of the device. Thus, apart from internal frictional losses, it will present no load to its drive device. Nevertheless, if failure is suspected it will still be desirable to drivingly disconnect the generator from the prime mover. The arrangement described in US 4,685,550 may not be able to perform disconnect under these conditions since very little load is transmitted

through disconnect device and hence very little axial force will occur between the inclined teeth.

According to a first aspect of the present invention, there is provided a drive disconnect device for releasably connecting an output shaft to a drive shaft, comprising a drive transfer element movable between a first position where it drivingly connects the drive shaft to the output shaft, and a second position where there is no driving connection between the drive shaft and the output shaft, and wherein at least one actuator is arranged to act against a first region of the drive transfer element so as to urge it to the second position.

It is thus possible to provide an arrangement in which at least one actuator acts directly on the drive transfer element. This ensures that the element can be moved irrespective of the load or torque being transferred through the drive disconnect device.

Preferably the at least one actuator is a fluid operated actuator.

The at least one mechanical actuator is advantageously in the form of a piston and cylinder with the piston spring biased to a predetermined position, for example a retracted position, where the piston does not engage the drive transfer element.

Preferably the or each piston is selectively connectable to a source of pressurised fluid via an electrically operable valve which has a bleed path to a low pressure region. This is advantageous as it stops leakage through the valve from triggering an unexpected or unscheduled operation of the disconnect device.

Preferably an accumulator is provided to maintain a sufficient store of pressurised fluid to operate the disconnect device. Thus the device can still be operated to perform a disconnect function even in the event of a loss of a source of pressurised fluid.

The use of pressurised fluid means that high mechanical loadings can be achieved from relatively small and light actuators. Furthermore, fluid flow can be controlled by electrically operated valves which themselves are small and light, and certainly much

lighter than would be required to obtain the same forces from a solenoid alone or through magnetic attraction.

Preferably a lock mechanism is provided to lock the drive transfer element in the second position. The lock may act directly on the drive transfer element or may act on one or more of the pistons in order to hold them in an extended or operated position.

Preferably the lock is a spring loaded pin or other detent that engages with the drive transfer element when it is at the second position. Advantageously the lock mechanism is external to the drive transfer element such that it can be reached and operated manually, for example by service technicians. This facilitates testing of the drive disconnect device by maintenance staff.

Preferably, the drive transfer element is biased, for example by a spring, towards the first position. This ensures that inadvertent disconnects do not occur as a result of vibration or dynamic loading.

Advantageously the drive transfer element is coaxially disposed with either or both of the drive shaft and the output shaft. Engagement between the drive transfer element and the drive shaft or the output shaft may be via drive dogs. The dogs may have inclined teeth giving rise to an axial load. However, the invention works equally well where the teeth are not so inclined.

Preferably the drive transfer element is in splined engagement with the output shaft. Thus the drive transfer element is axially slidable with respect to the output shaft and tends to stop rotating once the drive disconnect device has been operated. This in turn reduces the wear that may be experienced by a locking mechanism acting directly on the drive disconnect device to hold it in the disconnected position.

Preferably the fluid is a liquid, although pneumatic operation is also possible. In the context of an avionics environment supplies of pressurised liquid and pressurised air are routinely available.

Advantageously the drive transfer element includes a flange against which the at least one actuator and a spring bias element can act. The at least actuator may be in the form of an annular piston encircling one of the drive shaft and the output shaft. Indeed, if leakage of fluid from the actuator is not an issue, or can be tolerated for long enough, then the flange of the drive transfer element may in fact form part of the piston within a piston and cylinder actuator.

During the disconnect operation the actuator, which is held on a stator, comes into contact with the flange of the drive transfer element, which is rotating. The actuator does not have to endure the sliding contact with the flange for long. However it is advantageous for the contacting region of the actuator to be lubricated and/or formed or coated with a low friction material.

According to a second aspect of the present invention, there is provided a generator in combination with a drive disconnect device according to the first aspect of the present invention.

The present invention will further be described, by way of example only, with reference to the accompanying figure which is a schematic diagram of a drive disconnect device constituting an embodiment of the present invention.

The accompanying figure illustrates an arrangement in which a quill shaft 2 receives power, either directly or indirectly, from a prime mover (not shown) such as a gas turbine jet engine. The quill shaft 2 is in splined engagement with a annular element 4 which functions as a drive shaft. The drive shaft 4 has a first region 6 which engages with bearings 8 which act to support the shaft, and a second region 10 which has a castellated end section which forms drive dogs for drivingly engaging with a drive transfer element 12. The drive transfer element 12 has a similar castellated end region 14 which forms drive dogs which cooperate with the drive dogs 10 of the annular element 4. The drive transfer element 12 is coaxially disposed with respect to a rotor shaft 16 and is drivingly coupled thereto via splines 18. Thus the drive transfer element 12 does not undergo rotational movement with respect to the rotor shaft 16 but can slide axially with respect to the shaft

16. Line 20 in the figure represents an axis of rotational symmetry for the quill shaft 2, the drive shaft 4, the transfer element 12 and the rotor shaft 16.

The drive transfer element 12 has a circularly symmetric flange 22 disposed thereon, advantageously towards the end opposite to the drive dogs. The flange 22 has a first surface 24 which opposes a similar surface 26 on the rotor shaft and between which a compression spring 28 is held. The action of the compression spring is to urge the drive transfer element to move away from the surface 26 such that its drive dogs 14 interengage with the drive dogs 10 of the drive shaft 4. Stepped portions 30 and 32 of the flange 22 and on the rotor shaft 16 serve to hold the compression spring 28 in a position such that it is coaxially disposed about the rotor shaft 16. Thus, in use, rotation of the quill shaft 2 is transmitted to the drive shaft 4 via coupling elements therebetween, for example splines. Rotation of the drive shaft 4 is transmitted via the dogs 10 and 14 to the drive transfer element 12 which in turn transfers drive to the rotor shaft 16 via the splines 18. The drive transfer element 12 is held coupled to the drive shaft 4 via the action of the compression spring 28.

The annular flange 22 also defines a second surface 40 against which a piston 42 (which may for example be an annular piston or be a member of a group of one or more cylindrical pistons) can be urged to bear against by a virtue of pressurised fluid being admitted into a cylinder 44 within which the piston 42 is in substantially fluid sealed sliding engagement. The piston 42 is biased to a predetermined position, for example by a compression spring 46 which serves to hold the piston in position against possible movement that may be induced by vibration. The or each cylinder 44 is connected to a reservoir of pressurised fluid 48 via an electrically operable valve 50 and interconnecting ducts 52, which may for example be in the form of drillings. The reservoir of pressurised fluid 48 may receive fluid from a pump supply 54 via a one way valve 56. The electrically operable valve 50 may comprise a valve element 58, for example in the form of a spherical member, which bears against a cooperating valve seat under action of a biasing spring (not shown). The valve may include an internal duct 60 venting to low pressure such that leakage of fluid through the valve when it is in a position which notionally prevents the supply of fluid from the

reservoir 48 to the cylinder 44 can be drained away thereby ensuring that pressure does not build within the cylinder under the circumstances.

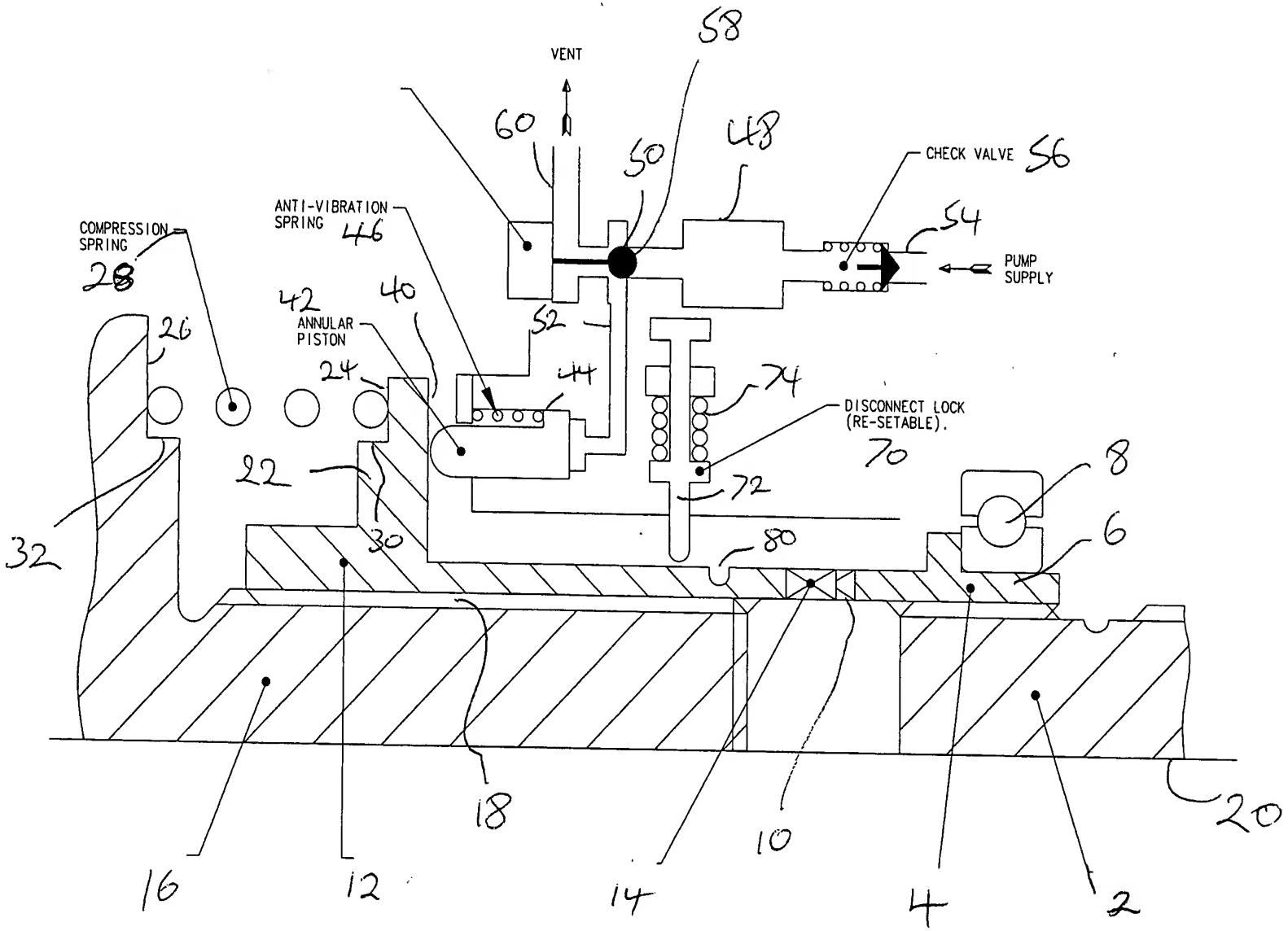
A resetable detent or lock mechanism 70, for example in the form of a plunger 72 biased to move to an extended position by a compression spring 74 may be provided in order to hold the drive transfer element 12 in a disconnected position once drive disconnection has occurred.

In order to envoke disconnection of the rotor shaft 16 from the drive shaft 4, an electrical signal is supplied to the valve 50 so as to energise a solenoid therein to move the valve element 58 away from sealing engagement with the valve seat, and simultaneously to close or at least obstruct the passageway 60 that vents to low pressure. Alternatively, the passageway 60 may include a constriction therein such that even though it does not become obstructed by the valve element 58, the rate of fluid leakage therethrough is maintained at acceptable levels. This second configuration is in fact preferable as it prevents a pressure differential across the valve element 58 from occurring during operation which may serve to prevent movement of the valve element 58 back to the position where it sealingly engages with the valve seat.

Following actuation of the valve, high pressure fluid from the reservoir 48 flows along the duct 52 and into the cylinder 44 where the increase in pressure urges the piston 42 to bear against the surface 40 and then to push the drive transfer element against the urging of the compression spring 28 to a disconnect position where the drive dogs 10 and 14 no longer interengage. As this occurs, an annular recess 80 formed in the drive transfer element 12 moves to a position whereby the end of the element 72 can engage the annular recess 80 thereby preventing further axial motion of the drive transfer element 12. Thus, the drive transfer element 12 becomes locked in the disengaged position and will remain there even when the supply of pressurised fluid to the piston 44 is removed.

It will be understood by the person skilled in the art that relatively small piston and cylinder arrangements fed from high pressure sources of fluid can produce large forces. Thus it is possible to provide a compact and lightweight actuation system which acts

directly on the drive transfer element 12 to move it to a disengaged position. Furthermore, it is possible to provide a fully testable system as the operation of the piston and the resetable disconnect lock 70 can be initiated and observed by maintenance personnel whilst the quill shaft 2 and hence the rotor is not rotating. This confers a significant advantage over prior art systems which are either difficult to test, difficult to reset, or require a torque to be transferred in order to initiate the disconnection process.


VENT
58
60
50
48
CHECK VALVE 56
54
PUMP SUPPLY
ANTI-VIBRATION SPRING 46
COMPRESSION SPRING 28
42
40
ANNULAR PISTON
52
26
24
44
74
DISCONNECT LOCK (RE-SETABLE).
70
22
72
8
6
32
30
80
18
10
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16
12
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